Stochastic Modelling for Prediction of Market Value of a Share

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Abstract

Market value of a Share is very sensitive and is affected by many concomitant variables like Fiscal policies of Governments, Financial position of the Company, Demand & supply position, Bark rate, National & International political scenario, Industrial relations, Trade cycles, Climatic conditions, Natural calamities, like floods, draughts, earthquakes and so on. Thus determination of Market value of a share is complex problem and many variables are to be studied at a time, which are changing at different time points, hence Market value of a share is a stochastic variable and model proposed should include many influencing variables and solutions to such models are complicated. To overcome this difficulty an easiest method to be predicts Market Value of a Share using Moving Averages Method. 3-day and 5- moving average models are proposed in this paper and suitability of model can be determined by Mean Square Error Concept (M.S.E.).. For this purpose we collectedMarket values from 1stJan 2013 to 19thNovember 2014 for the share Infosys Ltd., on working days BSE.

Keywords: *Stochastic variable, Market value of a Share, Moving Averages Method, Mean Square Error.*

Introduction

Investments in share market have attractivereturns, but at the same time it involves hidden risk factors. Hence one has to think properly before investing (or) purchasing a company share. A well experienced investor can predict the prosperity of a share based on the company's past history, fiscal policies of the Government, investment patterns in the past and in the future. This type of prediction is not a scientific one and often may go wrong because the decision taken is based on the past experience of the investor, but not done using scientific methods of predictions. Scientific predictions are also based on collection of the past data and analysis of the same through sophisticated techniques. Here also, there is a possibility of the decisions failing but the chances are very remote say 5% (or) 1% (or) still less, based on the techniques used. In this connection it is worth to mention that use of more recent Statistical techniques is very useful and helpful to take appropriate decisions by acommon investor. Thus there is a necessity to apply Statistical techniques to analyze the share market data collected through proper resources. This leads to a new research field known as "Market Research".

Market Research, now-a-days, occupies a vital place in modern research because it provides solutions to business problems through an appropriate model. A model is a replica of the real situation. If a business problem is represented through a mathematical equation then it is called

'Business Mathematical Model (B.M.M)'. Thus Business Mathematical Models play an important role in Market Research and are mainly based on the assumptions considered by the researcher. Such assumptions are necessary and inevitable to apply well known Mathematical tools and techniques, through which one can get solutions to the model proposed.Hence, the proposed model is to be modified by incorporating such new assumptions into the model, so that the modifiedmodel is closer to the reality. In Market Research probabilistic models proposed by Researchers are to be updated, because the variables under consideration inherently have stochastic nature. Thus stochastic models are more appropriate to deal with problems arising in Market Research than probabilistic models. This is very essential particularly to determine the behaviour of the MarketValue of a Share. Market value of a share is very sensitive and depends on many factors, their interrelationships, and fiscal policies taken by the Government/ Reserve Bank of India (RBI)/Stock Exchange Board of India (SEBI) and so on. Thus stochastic modelling is very essential in Market Research to detect the behaviour of the market value of a share. In stochastic modelling, we assume that the parameters of the distribution under study are functions of time variable't', whereas; these parameters are assumed as constants in 'Probabilistic models'.

In this paper, a Moving Average Model is proposed to predict the market value of the share by considering the market values of a share as 'Time Series'. A 3- day and a 5- day Moving Average models are fitted using Method ofLeast Squares and predictions are made using these fitted models. Closeness between the actual values and predicted values are calculated by using Mean Square Error (M.S.E.) concept and conclusions are drawn about the closeness of the model proposed and the reality. For this purpose we collectedMarket values from 1stJan 2013 to 19thNovember 2014 for the share Infosys Ltd. on working days BSE.

Approach

Let (ω, t) denote the random variable representing the market value of a share at time t, $\omega \in \Omega$ is the state space, measured in Rupees and $t \in T$ is the parametric space, where 't' represents a working day of the share market. Thus $X(\omega, t)$ is a Stochastic Variable with continuous state space and discrete Index Set.

In particular,Linear form of the 3-day Moving Averages model is $X_t = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + a_3 X_{t-3}$; Where are parameters and determined by using the principle of Least squares to the proposed data. Then the fitted 3-day moving average model to the proposed data is

$$\hat{X}_t = \hat{a}_0 + \hat{a}_1 X_{t-1} + \hat{a}_2 X_{t-2} + \hat{a}_3 X_{t-3}$$

Linear form of the 5-day Moving Averages model is

$$X_t = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + a_3 X_{t-3} + a_4 X_{t-4} + a_5 X_{t-5} \; ;$$

Where a_0, a_1, a_2, a_3, a_4, a_5 are parameters and determined by using the principle of Least squares to the proposed data. Therefore, the fitted 5-day moving average model to the proposed data is

$$\hat{X}_t = \hat{a}_0 + \hat{a}_1 X_{t-1} + \hat{a}_2 X_{t-2} + \hat{a}_3 X_{t-3} + \hat{a}_4 X_{t-4} + \hat{a}_5 X_{t-5}$$

The suitability of the model can be identified by using R^2, adjusted R^2 and Root Mean Square Error (M.S.E.)

$$MSE\left(\hat{X}_t\right) = E\left(\hat{X}_t - X_t\right)^2 = \frac{1}{n}\sum_{i=1}^{n}(\hat{X}_t - X_t)^2 .$$

Use of the M.S.E. as a criterion of accuracy of an estimator amounts to regarding two estimates that have the same MSE as equivalent. This is not strictly correct because the frequency distributions of errors $\left(\hat{X}_t - X_t\right)$ of different sizes will not be the same for the two estimates if they have different amounts of bias.

Implementation

Fitting of 3-day Moving Average Model: Here we assume that the Stochastic Variable 'X$_t$' depends on the Market value of the past '3' working days. In the first step we have calculated 3-day Moving Averages for companyShare Infosys Ltd.,and then we propose to fit a 3-day Moving Average model is as $X_t = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + a_3 X_{t-3}$; Where a_1, a_2, a_3 are unknown constants and 'X$_t$' represents the Market Value of a share on the 'tth' working day.

Root MSE	34.60529	R-Square	0.9925
Dependent Mean	1985.19589	Adj R-Sq	0.9925
CoeffVar	1.74317		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	11.38334	8.28431	1.37	0.1701
priceday1	1	0.95384	0.04743	20.11	<.0001
priceday2	1	0.07720	0.06534	1.18	0.2380
priceday3	1	-0.03530	0.04750	-0.74	0.4578

The fitted 3-day moving average model for the Company share Infosys Ltd., to the observed data is

$$X_t = 11.3833 + 0.9538 X_{t-1} + 0.0772 X_{t-2} - 0.0353 X_{t-3}$$

Fit Diagnostics for Marketvalue
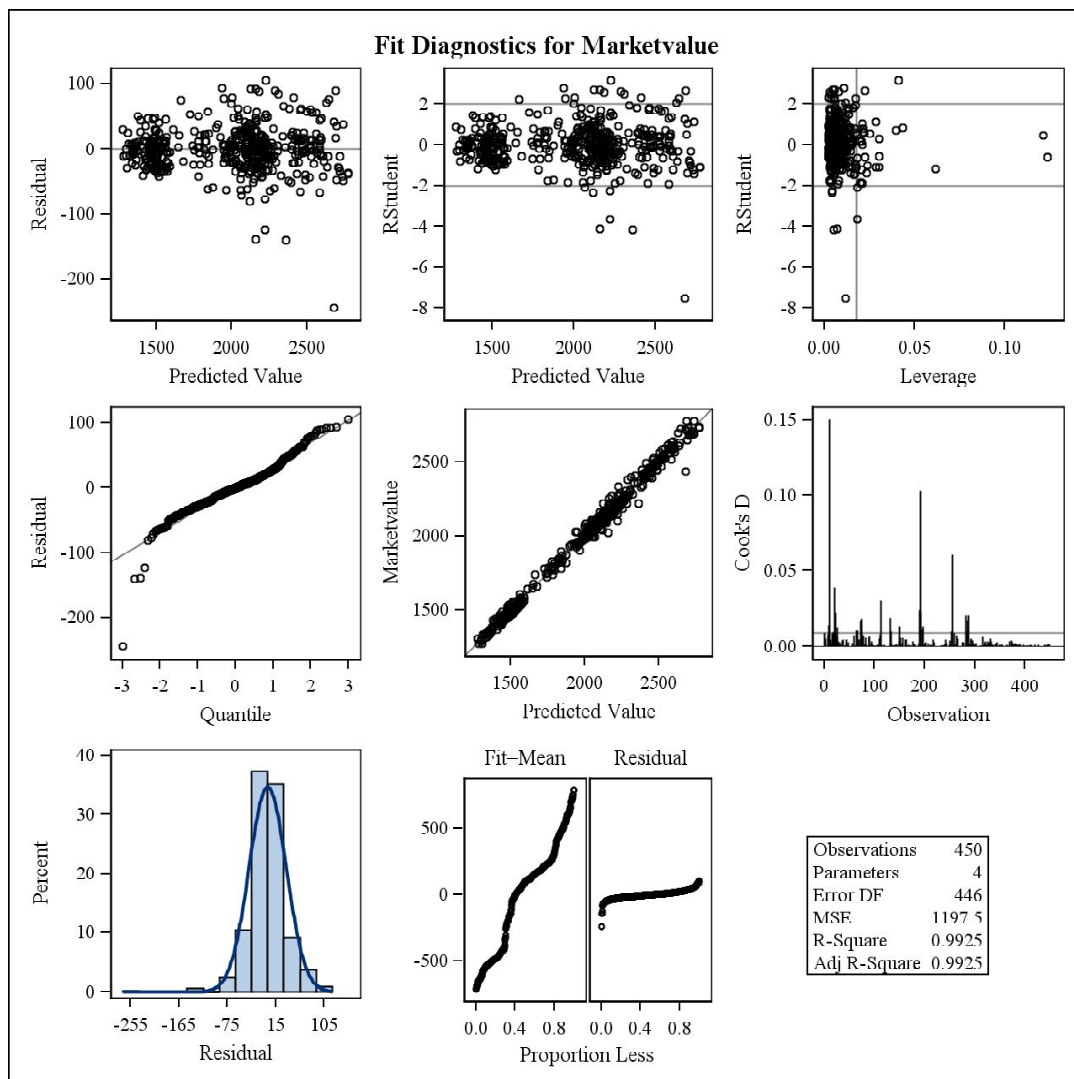
From the above 3-day moving average model and it can be shown that $R^2 = 0.9925$ & Adjusted $R^2 = 0.9925$. Thus 99.25%f the variability in present market value of a company share (x_t) by the 3-day moving average model. Mean Square Error (M.S.E.) of the 3-day moving average model is 1197.5 and Root Mean Square Error is 34.6053.

Fitting of 5-Day Moving Average Model: Usually our common sense says that future weekprices are depending upon present week prices and in a week usually we get '5' working days on an average (leaving apart holidays and Sundays for the Share market). Thus it is more appropriate to calculate '5' day trend values than '3' day trend values. Hence '5' day trend values are calculated from the data.Now we propose to fit a 5-day Moving Average model is as

$$X_t = a_1 X_{t-1} + a_2 X_{t-2} + a_3 X_{t-3} + a_4 X_{t-4} + a_5 X_{t-5};$$

Where a_1, a_2, a_3, a_4, a_5 are unknown constants and represents the Market Value of a

Root MSE	59.29503	R-Square	0.9816
Dependent Mean	3123.40178	Adj R-Sq	0.9814
CoeffVar	1.89841		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	18.46738	20.58578	0.90	0.3702
priceday1	1	0.97939	0.04751	20.62	<.0001
priceday2	1	-0.09849	0.06639	-1.48	0.1387
priceday3	1	0.12463	0.06629	1.88	0.0608
priceday4	1	-0.00211	0.06635	-0.03	0.9747
priceday5	1	-0.01050	0.04717	-0.22	0.8239

The fitted 5-day moving average model for the Company share Infosys Ltd., to the observed data is

$$X_t = 18.4674 + 0.9794 X_{t-1} - 0.0985 X_{t-2} + 0.1246 X_{t-3} - 0.0021 X_{t-4} - 0.0105 X_{t-5}$$

Fit Diagnostics for Marketvalue
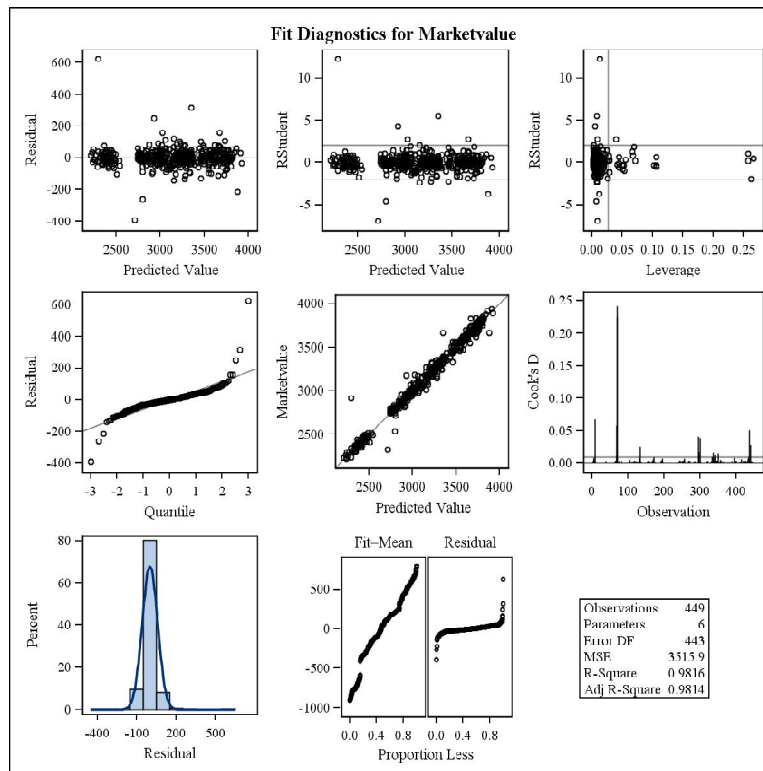
From the above 5-day moving average model and it can be shown that $R^2 = 0.9816$ & Adjusted $R^2 = 0.9816$. Thus 98.16%f the variability in present market value of a company share (x_t) by the 5-day moving average model. Mean Square Error (M.S.E.) of the 5-day moving average model is 3515.9 and Root Mean Square Error is 59.2950.

Prediction of the Market Value of a Share through the above Models

Using the 3-day and 5-day Moving Average models in the previous sections, now we proceed to predict the Market Value of a given Share and predicted values through these two models for Company share Infosys Ltd., and by using t-test we test the statistical significance of observed market values and predicted market values of the Company share Infosys Ltd., for 3-day and 5-day moving averages models are as follows:

Statistical significance for 3-Day Moving Average Model

| DF	t Value	Pr > |t|
8	3.07	0.0154

From the above table there is no significant difference between observed market values and predicted 3-day moving averages model for Company share Infosys Ltd.

Distribution of Difference: OBSERVE - EXPECTED
With 95% Confidence Interval for Mean
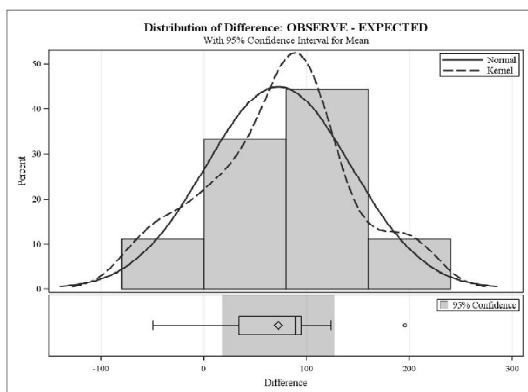
Statistical significance for 5-Day Moving Average Model

DF	t Value	Pr > |t|
6	3.20	0.0187

From the above table there is no significant difference between observed market values and predicted 5-day moving averages model for Company share Infosys Ltd.

Distribution of Difference: OBSERVE - EXPECTED
With 95% Confidence Interval for Mean
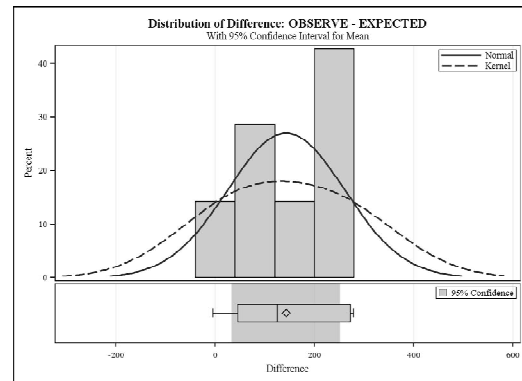
From the above distribution of difference between 3-day moving averages model and 5-day moving averages model, we conclude the predicted 3-day moving averages close to the reality when compared to 5-day moving averages model for Company share Infosys Ltd.

Concluding Remarks

Critically comparing R^2, adjusted R^2 and Mean Square Errors of company share Infosys Ltd., for 3-day and 5-day moving average models we conclude that Predicted Values of 3-day Moving Average models iscloser to Actual Values for the company share Infosys Ltd. Thus for this Company has3-day Moving Average model is more appropriate than 5-day Moving Average model, which further means that future week behaviour of the Market Value is depending upon the present the 3 daysbehaviour. Similar exercise can also be extended to other Companies also. This type of work is a routine exercise and using the computer helps one can do this as a simple and routine job. But there is

a necessity to develop Programs for different models under consideration. So that a common investor can analyse the behaviour of different Company Market Values of their Shares using such "computer packages". This type of analysis will help him to invest his savings in appropriate and more profitable Companies so that the returns from the investments are optimum.

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